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NOTES ON SYNENTOGNATHOUS FISHES

BY HENRY W. FOWLER.

The fishes embraced in this order are commonly known as bill-fishes or green-gars, sauries, half-beaks and flying-fishes. With one exception, as noted below, all are contained in the collection of the Academy.

BELONIDÆ.

At least two distinct sub-genera occur in the limits of *Belone* Cuvier. *Raphistoma* Rafinesque, as pointed out by Regan, may be accepted as a nomen nudum.

Sub-genus BELONE Cuvier.

Body compressed behind vent, without lateral keels. Gill-opening extends well forward. Gill-rakers moderate, lanceolate.

Belone belone (Linnaeus).

Eight from the Mediterranean.

PLATYBELONE new sub-genus.

Type *Belone platyura* Bennett.

Body broadly depressed behind, with strong lateral keels. Gill-opening rather restricted. Gill-rakers short points. (πλατύς, broad, with reference to the caudal peduncle; *Belone*.)

Belone platyura Bennett.

Two Hawaiian examples from J. K. Townsend. These examples are of interest historically, as among the first of the species obtained in the Hawaiian Islands, several years before Valenciennes described it as *Belone carinata*.

B. trachura Valenciennes also belongs in the present sub-genus.

STRONGYLURA Van Hasselt.

Bull. Sci. Nat. Férussac (2 sect.) II, 1824, p. 374. Type *Strongylura caudimaculata* Van Hasselt.

Strongylura Van Hasselt thus antedates *Tylosurus* Cocco,¹ and though without diagnosis is clearly based on the easily recognized

¹Giorn. Sci. Lett. Sicilia, XLII, 1833, No. 124, 18.

figure and account by Russell. *S. caudimaculata* Van Hasselt was deliberately proposed to avoid tautonomy and replace *Belone strongylura* Van Hasselt of the preceding year, while both specific names gained usage through the works of Bleeker. The species with large scales and blunt caudal fin may then remain in the sub-genus *Strongylura* Van Hasselt, while the larger and more finely-scaled species with forked caudals may contain *Tylosurus* Cocco.

Strongylura strongylura (Van Hasselt).

Philippines.

Strongylura notata (Poey).

A large series from Florida (Stuart, Boca Grande, Marquesas Keys, Big Pine Key, Hailer's Rock, Boca Chica Key, Bayport, West Palm Beach and Key West).

Strongylura scapulare (Jordan and Culver).

Panama.

Strongylura timucu (Walbaum).

Colon, and Santo Domingo, W. I.

Strongylura exile (Girard).

San Diego, Cal.

Strongylura peruana new species. Fig. 1.

Head, from tip of frontal process, $5\frac{1}{4}$; depth $1\frac{1}{2}$ in postocular; D. II, 12; A. II, 14; P. I, 10; V. I, 5; scales about 350 from opposite upper hind edge of gill-opening to caudal base medially; about 235 scales between occiput and dorsal origin; eye $2\frac{3}{4}$ in postocular; interorbital $2\frac{2}{5}$; first branched dorsal ray about $1\frac{1}{2}$; first branched anal ray about $1\frac{1}{4}$; pectoral 1; ventral $1\frac{3}{4}$.

Body elongate, moderately slender, cylindrical. Caudal peduncle cylindrical, or about broad as deep, least depth $1\frac{1}{2}$ in eye, and with slight keel each side behind for lateral line.

Head level above, flattened sides narrowly constricted below, width $1\frac{2}{3}$ in postocular. Jaws not completely closing basally, snout width at eyes long as frontal process. Eye little ellipsoid, close to upper profile though not impinging. Maxillary well exposed, reaches beyond front of eye or half way in front part of iris to pupil. Band of outer teeth in jaws very fine and narrow, and larger inner well spaced. No teeth on mouth roof. Tongue

elongate, pointed, free. Triangular nasal cavity about long as pupil. Interorbital and top of head with rather shallow concave median depression, not extending back to occiput. Few ridges or striæ on bones of head above. Opercle width about wide as cheek.

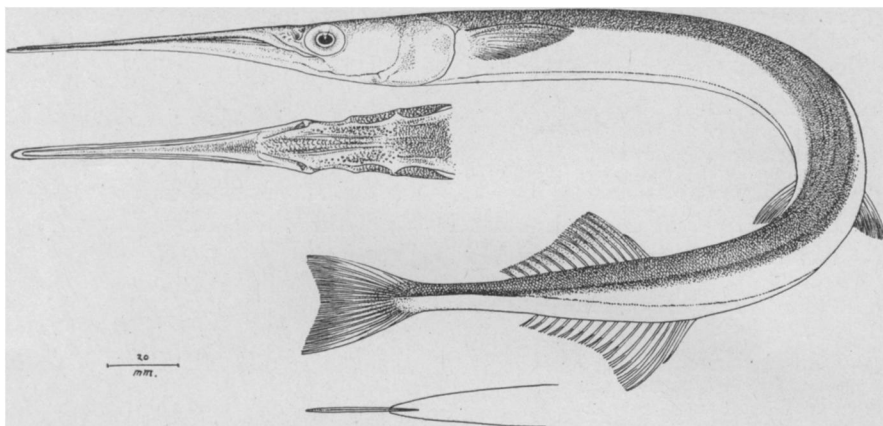


Fig. 1.—*Strongylura peruana*.

Gill-opening extends forward to front pupil edge. No rakers. Gill-filaments $1\frac{1}{2}$ in eye. Isthmus long narrow frenum.

Scales small, uniform, each with about 18 to 20, coarse complete circuli. Maxillary, sides of mandible basally, opercles, and most of head covered with fine scales. Cheek with about 30 rows of scales behind eye to preopercle ridge. Front of dorsal and anal basally with small scales. Lateral line with short branch to pectoral base, and behind extends up midway along caudal peduncle side on keel to caudal base.

Dorsal inserted about last fourth between hind eye edge and caudal base, front rays elevated as lobe. Anal similar, inserted little before dorsal. Caudal broad, hind edge (damaged) emarginate or with lower lobe slightly longer. Pectoral inserted little high pointed, and uppermost or simple ray enlarged. Ventral rather obtuse, inserted about midway between hind preopercle edge and caudal base. Vent about half an eye-diameter before anal.

Color in alcohol dull, brownish generally, sides and below paler or with brassy to silvery reflections. Narrow brassy-leadен streak

along side, most distinct at front of dorsal and anal. Iris pale. Fins all dull brownish.

Length (beak broken) 310 mm.

Type, No. 21,924, A. N. S. P. Callao Bay, Peru. Prof. James Orton. Collection of 1876-1877. Prof. E. D. Cope.

Only the type known. Allied with *Strongylura exile*, but differs in the shorter preorbital, less notched maxillary, slightly fewer branched dorsal and anal rays and larger scales. (Named for Peru.)

Strongylura marina (Walbaum).

A large series from Massachusetts (Wood's Hole); New Jersey (Barnegat, Great Bay, Atlantic City, Ocean City, Sea Isle City, Corson's Inlet, Newbold's Island, Florence and Duck Island); Pennsylvania (Delaware River, Philadelphia, Torresdale, Susquehanna River, Peach Bottom); Maryland (Chesapeake Bay, Elk Neck, Pool Creek, Charlestown, Ocean City); and Florida (Bayport and Boca Grande).

Strongylura leiuroides (Bleeker).

Philippines.

Strongylura anostomella (Valenciennes).

Hakodate, Japan.

Strongylura leiura (Bleeker).

Padang, Sumatra.

Strongylura raphidoma (Ranzani).

Kingston, Jamaica, and Culebra, Porto Rico.

Strongylura acus (Lacépède).

A series of all ages: Massachusetts (Nantucket); New Jersey (Sea Isle City and Ocean City); Pennsylvania (Susquehanna River); Mediterranean.

Strongylura coromandelica (Van Hasselt).

Padang, Sumatra.

Strongylura crocodila (Le Sueur).

Padang, Sumatra. Although I have only the present example from the East Indies, it differs slightly from one I identified as *Tylosurus choram* (Rüppell) obtained in the Camaroons. The

Padang fish differs in the maxillary reaching the pupil, gill-opening extending forward about to front pupil edge, longer hind dorsal rays and much finer scales, though the last structurally identical.

Xenentodon cancila (B. Hamilton).

Ganges River, India.

Potamorrhaphis guianensis (Schomburgk).

Peruvian Amazon and Rupununi River. *Potamorrhaphis eigenmanni* Ribeiro², from Paraguay, has D. 28, A. 25 and scales 136 to 150. My examples reveal an extent of variation not quite so low as these formulas, other characters well within the limits, and still others exceeding even some Dr. Ribeiro gives for *P. guianensis*.

Ablennes hians (Valenciennes).

St. Christopher's Island, British West Indies.

SCOMBERESOCIDÆ.

Scomberesox saurus (Walbaum).

Newport, R. I.; Cape Cod, Mass. Three from the Atlantic in the Bonaparte Collection.

HEMIRAMPHIDÆ.

Chriodorus atherinoides Goode and Bean.

Marquesas Keys and Hailer's Rock, Florida.

Hyporhamphus pacificus (Steindachner).

Hawaiian Islands.

Hyporhamphus neglectus (Bleeker).

Padang, Sumatra.

Hyporhamphus unifasciatus (Ranzani).

Colon, Canal Zone; St. Martin's, W. I.; Trinidad; Boqueron, Porto Rico; West coast of Mexico; Los Animas Bay, Lower California. Provisionally this species may be retained as the short-billed form, though I have but one example from the Boqueron lot and another from the west coast of Mexico as exceptions. None of the young appear to have longer beaks than the adults.

² Arch. Mus. Nac. Rio Janeiro, XVII, 1915, p. 13.

Hyporhamphus roberti (Valenciennes).

Newport, Rhode Island; Corson's Inlet, New Jersey; Volusia, St. Augustine, Key West and Point Puellas, West Florida. In most examples, or excepting the largest, which from Rhode Island, and another from Key West, the ventral origin is about midway between preopercle edge and caudal base. In the exceptions it is about midway between hind eye edge and caudal base. All, however, have the beak over twice the head length as measured after front eye edge.

Hyporhamphus kurumeus Jordan and Starks.

Chikugo River at Kurume, Japan.

EULEPIDORHAMPHUS new sub-genus.

Type *Hemiramphus sajori* Schlegel.

Distinguished from the sub-genus *Hyporhamphus* Gill by its very small scales, 90 to 100 in lateral series. (Εὖ, well; λεπίς, scale; ῥάμφος, beak.)

Hyporhamphus sajori (Schlegel).

Hakodate and Kushiro, Japan.

Hemiramphus intermedius Cantor.

Victoria, Australia. Though Günther says³ dorsal and anal scaleless, and Macleay⁴ apparently copies, McCoy⁵ shows the dorsal and anal scaleless. The last, however, indicated the dorsal entirely with broken or somewhat dotted horizontal dark lines, which are not clearly intended as scales. In my examples the membranes of the soft dorsal and anal are covered with fine narrow scales for at least $\frac{2}{5}$ basally.

Hemiramphus far (Forskål).

Philippines; Padang, Sumatra; Zanzibar.

Hemiramphus brasiliensis (Linnaeus).

Sea Isle City, New Jersey; Chesapeake Bay; Aguadilla, Porto Rico; St. Kitts and St. Croix, West Indies; Port Antonio, Jamaica; Christian Island, west coast of Mexico; Honolulu, Hawaiian Islands.

³ Cat. F. Brit. Mus., VI, 1866, p. 260.

⁴ Proc. Linn. Soc. N. S. Wales, V, 1881, p. 181.

⁵ Nat. Hist. Victoria, II, 1890, p. 133, Pl. 135, fig. 1.

Hemiramphus limbatus Valenciennes.

Philippines.

Hemiramphus quoyi Valenciennes.

Philippines.

Hemiramphus affinis Günther.

Apia, Samoa.

Zenarchopterus hendersoni new species. Fig. 2.

Head (from upper jaw tip) 4; depth $9\frac{1}{4}$; D. I, 12; A. II, 9; P. I, 7; V. I, 5; scales 45 in lateral series from shoulder to caudal base medially; 34 scales before dorsal to head; 5 scales above lateral line at dorsal origin, and 1 below at anal origin; snout $2\frac{1}{2}$ in head from upper jaw tip; eye 5; maxillary $2\frac{2}{3}$; interorbital $3\frac{1}{5}$; first branched dorsal ray about 4; first branched anal ray about $3\frac{2}{5}$; least depth of caudal peduncle $3\frac{3}{4}$; caudal $1\frac{2}{3}$; pectoral $2\frac{1}{4}$; ventral about 4.

Body moderately elongate and compressed, more especially behind dorsal and anal origins, and back at present much broader than belly. Caudal peduncle short, its length little less than eye.

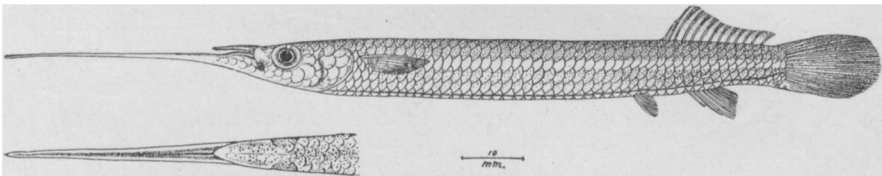


Fig. 2.—*Zenarchopterus hendersoni*.

Head well compressed, flattened sides narrowly convergent below, width $3\frac{1}{3}$ in its length from upper jaw tip. Upper jaw depressed, elongate, triangular, width at front of eyes $1\frac{1}{3}$ its length. Eye moderate, about half of snout, touches upper profile, and midway in head length. Mouth with rather long, horizontal gape, at least $\frac{2}{3}$ to eye. Maxillary concealed, reaches opposite nasal cavity. Teeth minute, conic, in narrow bands in jaws, though bands of lower only extend forward about $\frac{2}{3}$ as far as upper. Front maxillary edge with narrow band of fine teeth. No teeth on roof of mouth. Lower jaw produced as long, flattened beak,

edges entire, and head behind front eye edge about 3 in its length. Nasal cavity about $\frac{3}{8}$ of pupil, superior. Interorbital flattened.

Gill-opening extends forward about opposite front pupil edge. Gill-rakers 5+11, lanceolate, longest about $\frac{2}{3}$ of filaments and latter $2\frac{1}{3}$ in eye. Isthmus narrow slender frenum.

Scales moderately large, cycloid, rather narrowly imbricated, basal striæ 4 to 6, basal circuli 35 to 40 and terminal faces entire. Head scaly, a single row of large scales on cheek, and scales on opercles large. Several rows of small scales on caudal base, and dorsal and anal apparently without scales. Lateral line complete, low along side, and extends up behind just below median scale at caudal base, all tubes simple.

Dorsal inserted at last fourth between hind edge of gill-opening and caudal base, last ray reaching back little beyond latter. Anal inserted trifle behind dorsal origin, much shorter than dorsal. Caudal rounded behind. Pectoral placed high, small. Ventral inserted scarcely before last third in space between hind edge of gill-opening and caudal base, fins not quite half way to anal. Vent close before anal.

Color in alcohol pale, dull brownish generally, more or less uniform. Sides of head and below with traces of silvery reflections. A narrow silvery-gray lateral band, about wide as pupil, most conspicuous between dorsal and anal.

Length 142 mm.

Type, No. 7,584, A. N. S. P. Japan. Dr. A. A. Henderson.

This species, known only from the type described above, is closely related to *Zenarchopterus amblyurus* (Bleeker). According to Bleeker's figure⁶, it differs in the more posterior insertion of the ventral, shorter row of lower teeth, apparently more rounded caudal and scaleless dorsal fin. This specimen has long been in the Academy, probably sixty years or more, and still has the original labels intact.

(Named for Dr. A. A. Henderson.)

Zenarchopterus philippinus (Peters).

Philippines.

Zenarchopterus dispar (Valenciennes).

Philippines.

⁶ Atlas Ichth., VI, 1866-72, p. 61, Pl. 4, fig. 1.

Dermatogenys viviparus (Peters).

Philippines.

Euleptorhamphus velox (Poey).

Atlantic City, N. J.

Hemiexocetus caudimaculatus Fowler,

Proc. Acad. Nat. Sci. Phila., 1901, p. 293, fig. N. Lat. 23° W. Long. 106°
(Mazatlan, Mexico).

No. 7,508, A. N. S. P., type.

EXOCOETIDÆ.

Fodiator acutus (Valenciennes).

Panama.

Evolantia microptera (Valenciennes).

An example from south of the Revillagigedo Islands (Dr. Wm. H. Jones). The label says "from the stomach of a gannet captured June, 1875, 150 miles south of the Revillagigedo Islands, and stomach had 11 fish of same kind."

Parexocetus brachypterus (Richardson).

Hawaiian Islands.

Parexocetus mesogaster (Bloch).

Newport, Rhode Island; St. Martin's, West Indies.

Exocetus volitans Linnaeus.

Exocetus chilensis Abbott, Proc. Acad. Nat. Sci. Phila., 1860, p. 472. Chili.

Nos. 7498 and 7499, A. N. S. P., co-types of *E. chilensis* Abbott. Others from the Atlantic Ocean, "in the tropics," Indian Ocean, Hawaii and Victoria, Australia.

Cypselurus exsiliens (P. L. S. Müller).

N. Lat. 31° 30' W. Long. 36° 36'.

Cypselurus rondeleti (Valenciennes).

Two adults, Gulf of Mexico and the Bonaparte Collection, respectively.

Cypselurus polyethmus new species. Fig. 3.

Head $4\frac{3}{4}$; depth 6; D. 11, 9; A. 11, 10; P. 11, 15; V. 1, 5; scales (pockets) about 40 counted from shoulder to caudal base medially; 27 scales before dorsal to occiput; about 8 scales (pockets) above

l. l. to dorsal origin; snout $3\frac{3}{4}$ in head, measured from upper jaw tip; eye $3\frac{1}{8}$; maxillary $3\frac{3}{4}$; interorbital $2\frac{1}{5}$; least depth of caudal peduncle $3\frac{3}{4}$.

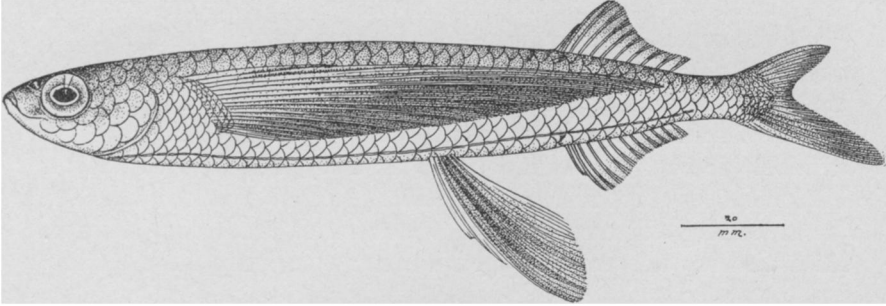


Fig. 3.—*Cypselurus polyethmus*.

Body elongately fusiform in contour, deepest medially, broad and depressed above forward, and becoming well compressed behind. Caudal peduncle compressed, least depth $1\frac{2}{3}$ its length.

Head broadly depressed above, flattened sides narrowly constricted below, width $1\frac{2}{3}$ its length, and lower profile much more inclined. Snout broadly depressed, length $\frac{2}{3}$ its width. Eye high, large, impinging slightly on upper profile, hind pupil edge slightly in advance of head center. Mouth small, with short gape, and mandible slightly protruding beyond snout tip. Teeth minute, feeble, only a few scattered along front edges of trenchant jaws, which otherwise smooth. Mouth roof toothless. Maxillary largely concealed, only narrow lower edges exposed, reaches eye. Tongue smooth, depressed, moderately long, front end rounded and free. Nasal cavity triangular, about half of pupil. Preorbital $1\frac{2}{3}$ in eye. Interorbital broad, level.

Gill-opening extends forward to nasal cavity. Gill-rakers 9+21, lanceolate, very slightly less than filaments which $1\frac{1}{2}$ in eye. Isthmus slender frenum in front.

Scales large, very caducous, cycloid, rather narrowly exposed, largest anteriorly on back and head above, basal radii 4 to 6, circuli complete, about 36 to 40. Dorsal and anal apparently scaleless, though caudal base scaly. Head covered with scales, though apparently edge of snout rather broadly naked. Breast covered with moderately small scales.

Dorsal origin about last third in space between hind gill-opening edge and caudal base, front rays a little elevated. Anal inserted

about opposite dorsal origin, similar to dorsal. Caudal well forked, lobes pointed and lower apparently much longer (damaged) and about long as head. Pectoral long, reaches back to last dorsal ray base, its first and second uppermost rays simple. Ventral inserted slightly nearer head than caudal base, reaches back not quite so far as pectoral or about $\frac{2}{3}$ to caudal base, with median branched ray longest. Vent close before anal.

Color in alcohol pale brown on back, sides and below silvery-whitish. Dorsal and caudal pale, medially tinged with brown. Pectoral deep brownish over greater median portion, blackish inside, though extreme inner edge and whole outer edge whitish. Anal whitish, also ventral, though latter with quite large median lengthwise brownish area. Iris whitish and muzzle pale.

Length 175 mm.

Type, No. 7,493, A. N. S. P. Atlantic Ocean. C. L. Bonaparte (No. 346).

Only the above described example known, which differs from *Cypselurus rondeleti* in the shorter pectoral and more numerous gill-rakers. My examples of *C. rondeleti* show the pectoral reaching the caudal base and the gill-rakers 7+15, though the larger 248 mm. long.

(πολλοί, many; ῥέθροσ, strainer, or gill-raker, as here understood.)

Cypselurus vinciguerræ (Jordan and Meek).

Adult from Gulf of Mexico.

Cypselurus hyperistius new species. Fig. 4.

Head $4\frac{1}{8}$; depth 6; D. II, 9; A. II, 9; P. I, 17; V. I, 5; scales 50 counted from shoulder to caudal base medially and 4 more on latter; 31 predorsal scales to head; 7 scales above l. l. to dorsal origin; snout 4 in head, measured from upper jaw tip; eye 3; maxillary $3\frac{3}{4}$; interorbital $2\frac{1}{4}$; least depth of caudal peduncle $3\frac{1}{2}$.

Body elongate, robust forward where also constricted below and upper surface broadened, though posterior regions well compressed. Caudal peduncle well compressed, least depth about $1\frac{2}{3}$ its length.

Head broadly depressed above, flattened sides narrowly constricted below, width $1\frac{1}{2}$ its length, and front profiles about evenly inclined. Snout moderately broad, conic, length about $\frac{2}{3}$ its width. Eye very large, high, greatly impinging on upper profile, and hind pupil edge slightly advanced from center in head length.

Mouth small, with short inclined gape, and mandible slightly protruded beyond snout tip. Teeth small, simple, conic, and as very narrow band or row along front edges of trenchant jaws. Mouth roof toothless. Maxillary well exposed, or at least lower half its whole length, extends slightly beyond front of eye or not quite half way in iris to pupil. Tongue smooth, depressed, moderately long, front end rounded and free. Nasal cavity close before eye, about half of pupil. Preorbital rather slender, $1\frac{1}{2}$ in eye. Interorbital broad, slightly concave.

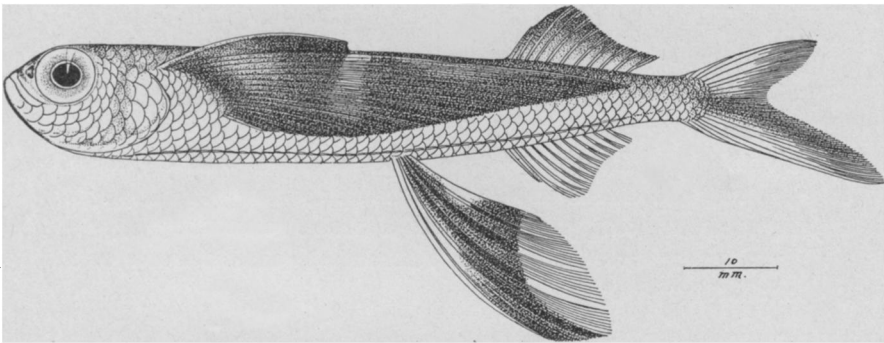


Fig. 4.—*Cypselurus hyperistius*.

Gill-opening extends forward to front eye edge. Gill-rakers $7+17$, lanceolate, about long as filaments, which slightly less than 2 in eye. Isthmus long slender frenum in front.

Scales large, mostly adherent, cycloid, moderately exposed, largest anteriorly on back and head above, basal radii 3 to 5, circuli complete, about 26 to 30. Dorsal and anal apparently scaleless, though caudal base scaly. Head covered with scales, 2 or 3 rows on cheek and edge of snout rather broadly naked. Breast scales of moderate size. Lateral line apparently not beyond anal as squamation damaged.

Dorsal origin at last third between hind pupil edge and caudal base, front rays a little elevated. Anal origin slightly before that of dorsal, fin similar. Caudal well forked, lobes pointed and lower much longer or about equals head and eye length. Pectoral long, reaches back not quite far as last depressed dorsal and anal rays, thus not quite to caudal base, and first or uppermost simple ray connected with next or first branched ray by broad membrane. Ventral inserted midway between hind eye

edge and caudal base, simple ray about $\frac{3}{4}$ length of first branched ray which longest, fin thus reaching slightly nearer caudal base than last depressed dorsal or anal rays. Vent close before anal.

Color in alcohol with back and upper surfaces dull brownish, sides and below silvery-whitish, also iris. Muzzle pale, and broad, dull blackish streak on chin to front of branchiostegals. Dorsal and caudal pale brownish, ends of long front rays of former blackish. Anal whitish. Pectoral with membranes largely blackish, lower face of fin with silvery tinge, inner edge whitish and at point near basal $\frac{2}{3}$ pale cross-bar half way from upper edge. Ventral largely blackish medially, edges and end broadly whitish.

Length about 92 mm. (Caudal tip damaged.)

Type, No. 7,485, A. N. S. P. St. Martins, West Indies. Dr. R. E. Van Rijgersma.

Only the type known. This species is allied with *Cypselurus vinciguerræ*, but differs in the uppermost or elongate simple ray of the pectoral being provided with a broad membrane.

(Ὑπερ, over; ἱστίον, sail; with reference to the structure of the pectoral fin.)

Cypselurus speculiger (Valenciennes).

Atlantic Ocean.

Cypselurus rufipinnis (Valenciennes).

Exocetus scylla Cope, Trans. Amer. Philos. Soc. Phila., (n. s.) XIV, 1871, p. 481. Tobasco, Mexico.

No. 7,500, A. N. S. P., type of *E. scylla* Cope.

Cypselurus heterurus (Rafinesque).

St. Martins, West Indies.

Cypselurus lutkeni (Jordan and Evermann).

Exocetus lutkeni Jordan and Evermann, Bull. U. S. Nat. Mus., No. 47, I, 1896, p. 736. "Cape San Antonio, Cuba." (Evidently erroneous.)

No. 7,502, A. N. S. P., type of *E. lutkeni* Jordan and Evermann.

Cypselurus furcatus (Mitchill).

Atlantic Ocean and Newport, R. I.

Cypselurus bicolor (Valenciennes).

S. Lat. 18° 20' 5" W. Long. 34° 5'.

Cypselurus nigricans (Bennett).

Sea Isle City, N. J.

Cypselurus lineatus (Valenciennes).

One mile north of Funchal, Madeira (September 17, 1912).
Joseph Redl.

Cypselurus bahiensis (Ranzani).

An example about a foot long, was kindly loaned to me by Dr. P. P. Calvert, now in his possession. It "flew" on board a vessel off the coast of Brazil.

Cypselurus californicus (Cooper).

San Pedro, California. Also others from Santa Catalina, received from Messrs. Morgan Hebard and J. A. G. Rehn.

Cypselurus agoo (Schlegel).

Tsuruga, Yokahama and Miyako, Japan.

Cypselurus quindecimradiatus Fowler.

Cypselurus quindecimradiatus Fowler, Proc. Acad. Nat. Sci. Phila., 1899,
p. 482, Pl. 17. Thornton Island, South Pacific.

No. 23,275, A. N. S. P., type of *C. quindecimradiatus* Fowler.

Cypselurus simus (Valenciennes).

Honolulu, Hawaiian Islands.

Cypselurus gibbifrons (Valenciennes).

Newport, Rhode Island.